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THE EFFECT OF ZINC BACITRACIN ON SILAGE MICROORGANISMS 1/

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During recent years several investigators have studied the effects of antibiotics in silage fermentations. The results obtained have not been consistent and the probable mode of action remains ill defined. Dexter (2) treated alfalfa with terramycin, neomycin, penicillin, bacitracin and aureomycin at 2 to 50 p.p.m. prior to ensiling and obtained variable results. Later work was carried out by Andrews and Stob (1) and Rusoff (3). These workers added zinc bacitracin to different types of forages and concluded that it could be used effectively as a silage preservative. Rusoff suggested that the function of zinc bacitracin in forage is to inhibit putrefactive bacteria and stimulate lactic acid producing bacteria.

Zinc bacitracin has a narrower antibacterial spectrum than many of the antibiotics and is generally more active against Gram-positive bacteria. Since both the lactic acid producing bacteria that produce beneficial acids and clostridia that cause deterioration in silage are Gram-positive it seemed doubtful that one group would be stimulated and the other repressed.

This work was undertaken to determine the effects of zinc bacitracin on typical strains of silage bacteria.

The strains studied included streptococci, leuconostocs, pediococci, lactabacilli, sporeforming aerobes, Gram-negative bacteria and sporeforming anaerobes.

The results in Figure 1 show the effects of zinc bacitracin on the growth of certain lactic acid bacteria. With the exception of one group, all of the strains studied grew in the presence of the antibiotic at 5 and 20 p.p.m. The effects on the growth curves of the bacteria at the concentration tried were not serious although some lengthening of the lag phase was observed. The most pronounced

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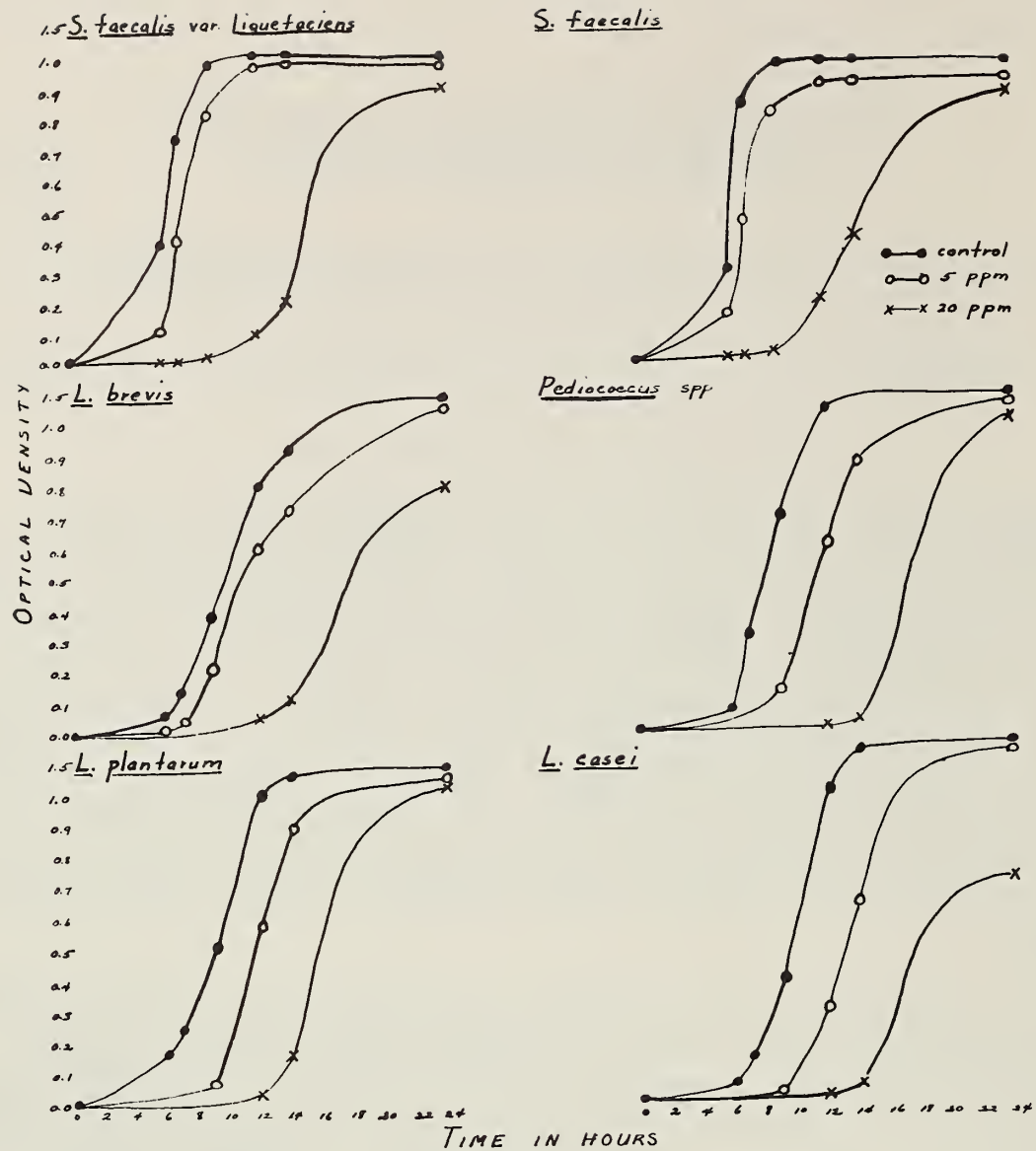


FIGURE 1.--The Effect of Zinc Bacitracin on Growth of Lactic Acid Bacteria

effect on the growth rate of the strains was found with Lactobacillus brevis and Lactobacillus casei at 20 p.p.m. With these two exceptions about the same density of cells was observed when the final readings were taken.

One important group of lactic acid producing bacteria (Leuconostoc) usually found in the early stages of silage fermentations was unable to grow in the presence of the antibiotic at 5 p.p.m.

The sporeforming anaerobes (Figure 2) showed some variation in their ability to grow in the presence of zinc bacitracin but were generally able to tolerate higher concentrations than the lactic acid bacteria. Three strains of Clostridium sporogenes responded similarly and grew well in the presence of the antibiotic in concentrations up to 50 p.p.m. These organisms were of particular interest because of the part they play in the deterioration of silage. Another spoilage organism (Clostridium tyrobutyricum) which converts lactate to butyrate in silage grew well at 5 p.p.m. but gave delayed growth at 20 p.p.m.

Further attempts to determine the effectiveness of zinc bacitracin as a silage preservative were carried out in forage slurries and in 4' x 8' experimental silos. The results obtained from slurries are given in Table 1. The slurries were prepared under anaerobic and aerobic conditions with concentration of zinc bacitracin at 5, 20 and 50 p.p.m. and were examined at different intervals up to one week. In the anaerobic slurries the control was about one pH unit lower than slurries containing the antibiotic. At 48 hours most of the sugar in the control had disappeared but the majority of the sugar in the slurry containing 50 p.p.m. zinc bacitracin remained.

Similar results were observed in aerated slurries although the pH value of the aerated control was higher and less sugar was fermented than in the anaerobic control.

The plant material ensiled in 4' x 8' experimental silos was composed of 80 percent ladino clover and 20 percent brome grass. Six silages were examined, two controls and four containing 5 p.p.m. zinc bacitracin two of which were aerated. Considering the type of the forage ensiled, the high moisture content, and the effect of aeration, some of the silages might have been suspected of yielding poor quality. However, the pH values of the forages were indicative of normal fermentations and only minor differences were observed in total viable bacterial counts.



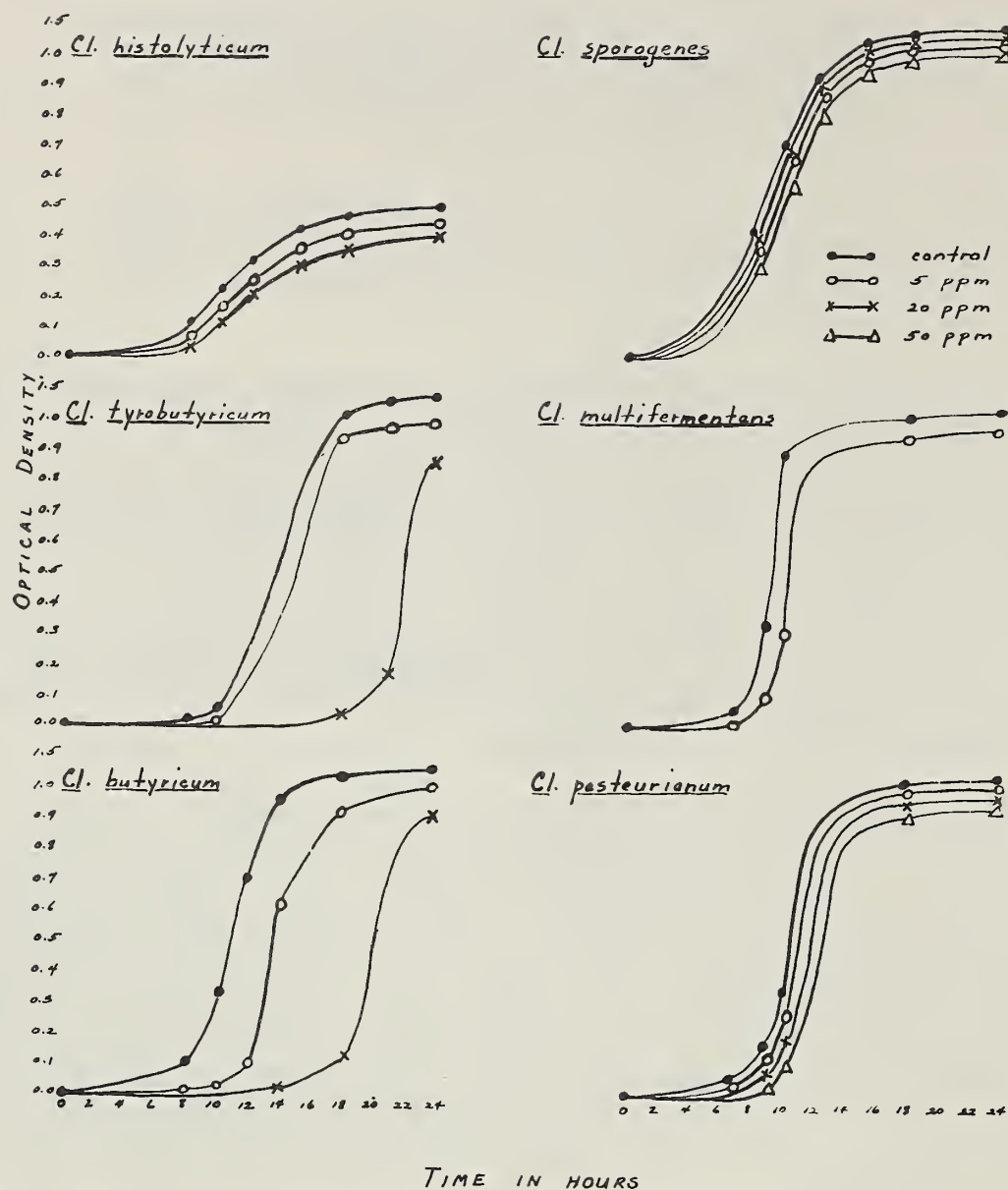


FIGURE 2.--The Effect of Zinc Bacitracin on Growth of Sporeforming Anaerobes

TABLE 1

EFFECT OF ZINC BACITRACIN\* ON THE FERMENTATION  
OF ALFALFA SLURRIES UNDER ANAEROBIC AND  
AEROBIC CONDITIONS

Slurry Number	Zinc bacitracin added		pH					Percent sugar used in 48 hrs.
			0 hr.	12 hr.	24 hr.	48 hr.	1 wk.	
A-1	None	Anaerobic	5.95	5.30	5.50	4.68	4.60	94
A-2	5 p.p.m.		5.90	5.58	5.58	5.22	5.62	
A-3	20 p.p.m.		5.90	5.49	5.49	5.49	5.32	
A-4	50 p.p.m.		5.90	5.71	5.66	5.71	5.43	
B-1	None	Aerobic	5.95	5.40	5.59	5.40	5.49	76
B-2	5 p.p.m.		6.00	5.40	5.49	5.57	5.41	
B-3	20 p.p.m.		6.00	5.60	5.68	5.85	5.75	
B-4	50 p.p.m.		6.00	5.60	5.57	5.58	5.58	

\* Zinc bacitracin added as silotracin.

## Summary and Conclusions

The data obtained suggest that if zinc bacitracin has a preserving effect in silage its mode of action is not that of stimulating lactic acid bacteria and inhibiting putrefactive organisms. In fact, the antibiotic was slightly inhibitory to the lactics during the initial growth phase. Furthermore, one group of the lactic acid producing bacteria was completely inhibited at low levels of the antibiotic. This might cause a disturbing effect during the early stages of the silage fermentation.

The spoilage organisms from silage were not appreciably affected by levels of zinc bacitracin which are normally added to forage. The putrefactive strains tolerated 50 p.p.m.

The results showed that zinc bacitracin had no beneficial effects in silage slurries. If any preserving effect of the antibiotic was to be expected, it might have been found in the slurry experiments since controls failed to develop normal acidities. This was true especially in the aerated slurries.

No conclusive evidence was obtained to show a preserving effect of zinc bacitracin on forage ensiled in 4' x 8' experimental silos because attempts to produce silage of inferior quality failed.

## References

- (1) Andrews, F.N., and Stob, M. Effect of molasses and bacitracin on the Estrogenic activity of silage. J. Dairy Sci., 41:1616. 1958
- (2) Dexter, S.T. The use of antibiotics in making silage. Agron. J., 49:483 1957
- (3) Rusoff, L.L. An antibiotic as a silage preservative. (Paper presented at the Southwest Regional ACS meeting, Dec. 5, 1959, Baton Rouge, La.)







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